Interspecies Animal ”Friendships”

”Vänskap” mellan olika djurarter

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1.Summary

Even though conspecific close relationships are well documented, scientific studies done on interspecies close relationships are scarce. There is no agreement of using the word friendships without inverted commas when describing close relationships of animals. But here in this thesis, I would like to use the word friendships when describing close animal relationships without inverted commas. However, many such friendships have been reported all over the world. Therefore the aim of this master thesis was to investigate the nature of interspecies friendships and which factors that could affect the beginning and continuation of such friendship by using videos available at YouTube.

Five research questions were asked during this thesis: (1) Did animals that have developed interspecies friendships experienced a stress event, (2) Does play facilitate to start and develop a friendship between two species, (3) Do young animals tend to engage in interspecies friendships more often than older animals, (4) Do interspecies friendships occur more often under human captivity than in nature and, (5) Are there any risks involved with having interspecies friendships.

In this project hundred YouTube videos showing interspecies friendship that included 57 different animal species were behaviourally recorded and analysed using SAS 9.2 software. In addition, three selected videos out of the hundred videos were analysed in detail using behaviour sequences. This was done to identify in which order behaviours occur during some specific interspecies friendships.

Four stress events that appeared to have facilitated the development of interspecies friendships were identified: being orphan, separation from the mother, unfavourable environment, and predator encounter. The first four most often recorded behaviours during interspecies friendships were social play, proximity to each other, social bonding and neutral behaviours. Most of the videos with interspecies friendships had been filmed in captivity and only few in the wild. The different major captive environments that these friendships had been filmed in were identified as: at private homes, in wildlife parks, orphanage, zoological gardens, and on farms. The films showed interactions between animals that in 91.4% were young (less than 12 months) and in 8.6% were adults (more than 12 months). Adult animals seemed to perform more social bonding and proximity whereas younger animals seemed to perform more play behaviour together. On films no injuries or risks to the animal welfare were observed. Interspecies friendships have been reported in the literature to involve some risks and they have been identified as: stress, anxiety, accidents, converting friendships into predator-prey relationship, increased vulnerability as a prey and sudden aggression.

The conclusions from this study are that the filmed animals appeared to have experiences some sort of stress event prior to developing interspecies friendships. Play was a common behaviour during interspecies interactions on the films. The major part of the filmed animals were less than one year. Interspecies friendships were more often filmed in human captivity than in nature. Interspecies friendships are not always beneficial but involve risks.

1. Sammanfattning

Så kallad vänskap mellan individer inom samma djurart är väl dokumenterat, men vetenskapliga studier på vänskap mellan olika djurarter är få. Emellertid har många sådana vänskaper rapporterats över hela världen. Syftet med detta mastersarbete var därför att med hjälp av YouTube filmer försöka förstå vilken typ av vänskap som finns mellan olika arter och vilka olika faktorer som kan påverka bildandet och bevarandet av sådan vänskap. Fem forskningsfrågor ställdes i början av undersökningen: (1) Har djur som har utvecklat mellan-arts vänskap" upplevt en stressande händelse? (2) Kan lek underlätta starten och utvecklandet av vänskap mellan två arter? (3) Tenderar unga djur att engagera sig i vänskap mellan arter oftare än äldre djur? (4) Förekommer vänskap mellan arter oftare i mänsklig fångenskap än i naturen? (5) Finns det några risker med vänskap mellan arter?

I detta mastersarbete letades 100 videofilmer som visar vänskap mellan olika djurarter upp från YouTube. Filmerna omfattade tillsammans 57 olika djurarter. Data på beteende och annan information lades in i Excel-ark och deskriptiva dataanalyser gjordes med hjälp av SAS version 9,2. Dessutom har tre utvalda filmer av de ursprungliga filmerna analyserats i detalj med hjälp av beteendesekvenser. Detta gjordes för att identifiera i vilken ordning beteenden inträffar under vissa specifika interaktioner mellan arter.

Fyra stresshändelser som föreföll ha underlättat utvecklingen av vänskap mellan olika arter identifierades: att vara föräldralös, separation från modern, ogynnsam miljö, och rovdjursmöten. De fyra oftast inspelade beteendena under vänskap mellan olika arter var social lek, närhet till varandra, social bindning och neutrala beteenden. De flesta av filmerna som visade vänskap mellan arter hade filmats i fångenskap och endast ett fåtal i naturen. De olika fångenskapsmiljöer som dessa vänskaper mellan olika arter huvudsakligen hade filmats i identifierades som: i privata hem, i viltreservat, på hem för övergivna djurungar, på zoologiska trädgårdar och på lantbruksgårdar. Filmerna visade interaktioner mellan djur som i 91,4 % var unga (yngre än 12 månader) och i 8,6% var vuxna (äldre än 12 månader). Vuxna djur verkade ha mer social bindning och närhet medan yngre djur verkade utföra mer lekbeteende tillsammans. På filmerna observerades inga skador eller risker för djurens välbefinnande. Vänskap mellan arter har i litteraturen rapporterats innebära vissa risker, och de har identifierats som: stress, ångest, olyckor, skifta vänskap till rovdjur-bytesdjur relation, ökad sårbarhet som bytesdjur och plötslig aggressivitet.

Slutsatserna från denna studie är att de filmade djuren verkar ha upplevt någon typ av stressande händelse innan de utvecklade vänskap med en annan art. Lek var ett vanligt beteende under interaktionerna mellan olika arter på filmerna och den största andelen av djuren var under 12 månader. Vänskap mellan olika arter var oftare filmade i fångenskap än i naturen. Vänskap mellan olika arter är inte alltid värdefulla utan innebär även risker.

2. Introduction

2.1 Background

The value of friends has been discussed even by Aristotle in the 4th century BC as, "Without friends no one would choose to live" (Massen *et al*., 2010). When some individuals interact with each other with comparatively more affiliation behaviours than other members in the group, they are called friends (Cords, 2002; Massen *et al*., 2010). Friendships between two different animal species in the animal kingdom have not been studied scientifically in depth until recently. The published literature on this topic is scarce. Therefore scientific literature on intraspecific relationships of animals and some limited amount of scientific literature from human friendships have been used. In addition, information from scientific blogs were used. I avoided using literature on friendships between animals and humans as I thought relationships could be affected by domestication and training.

Interspecies friendships have been documented more than ever before as a result of the development and popularity of internet and especially YouTube. While some scientists accept the existence of such friendships others remain sceptical. The word friendship is commonly used when describing close bonds among humans. However, scientific community is reluctant to use the word friendships when it comes to animals and they describe animal friendships as social bonds instead (Brent *et al*., 2013). However, primatologists have started to use the word friendship in order to describe close relationships among monkeys and apes (Silk, 2002).

According to a scientific blog article, animal friendships are not a wonder for someone who has lived with more than one dog or cat or any other social animal for some period of time and Friendships occur in all species and the scientific community would eventually be aware of this (Bekoff, 2015). However, some researchers believe that these amicable relationships are just stories about human impacts on the environment (Goode, 2015).

Interspecies friendships occur between predators and their usual prey including cat and a bird, hamster and a snake, a lioness and an oryx according to a scientific blog article (Bekoff, 2012). The mystery of why such interspecies animal friendships occur and the benefits of such relationships are still unsolved. In many cases certain form of stress events has happened such as separation from the mother or social group. Stress may facilitates forming friendships for example, friendship between a dog and a deer (BBCHDDocumentary, 2013), friendship between an elephant and a sheep (Ymouse, 2013). Some animals tend to care for an animal of another species perhaps due to high level of mothering instincts (RT, 2012). According to a scientific blog article it is accepted that animals can display and feel different emotions such as compassion, empathy, pleasure, and happiness (Bekoff, 2012). The structure and neurochemicals in the limbic system (the part of the brain that is responsible for the processing and expressing what an individual feels) is same in all mammals and therefore all mammals could have more or less similar emotions as described in the same blog article (Bekoff, 2012).

2.2 Definitions of friends

There is no concise definition of friends among different animal species in the ethology literature. Future studies will be benefited by a proper definition and it has been suggested that some criteria for a definition such as sustainability, mutuality, and some sort of

modification in behaviour or in communication. (King, 2010; Brent *et al*., 2013). According to a scientific blog article, these suggestions might be used as guidelines that assess the nature of a relationship between or among individuals in the animal kingdom (Bekoff, 2015). According to Brent et al. (2013), friends are pairs that show bidirectional affiliation (nonaggressive, non-reproductive) interactions with some specific frequency and consistency. Friends have more affiliation interactions (spending time together, conversing, vocalizing, grooming, huddling, cooperatively foraging, sharing food, forming alliances against others) with each other than non-friends (Brent *et al.,* 2013). Males and females that interact only when the female is sexually receptive are not friends but sexual partners that constantly have affiliation interactions over a period can be considered as friends (Brent *et al*., 2013). It has also been suggested that, "friends or social associates are defined as non-kin individuals that regularly are involved in affiliation behaviours" (Massen *et al*., 2010).

2.3 Measures of friendship

Primate researchers have suggested proximity measures and affiliated body contact (i.e. grooming) preferences as two important general measures of friendship (Silk, 2002; Massen *et al*., 2010). Depending on this, Massen *et al.* (2010) ha**ve** argued for the possibility of using these measures in order to describe social relations of any species including humans without limiting it to primates. During the proximity measure related to two individuals, the amount of time spend near each other is considered (Cords, 2002; Massen *et al*., 2010). As close proximity cannot occur by coincidence, and it mirrors some sort of tolerance for a given animal, such dyads are known as friends (Massen *et al*., 2010). Among many primate species, grooming has become one of the main forms of affiliation contact behaviours even though the New world monkeys as an example, spider monkeys, do not show grooming and show embraces instead (Schaffner & Aureli, 2005; Massen *et al.,* 2010).

2.4 Conspecific friendships

When it comes to humans, friendships consist of a number of properties or components such as intimacy, supportiveness, companionship, loyalty, trust, commitment, affection, acceptance, sympathy and concurring for the others welfare (Silk, 2002). It has been suggested that close social bonds can increase the trust among chimpanzees and that is one of the main elements of friendship in humans (Silk, 2016). Even though most of the relationships in the animal kingdom exist between closely related individuals (kin) such as daughter-mother pairs (giraffes, red deer, bison and elephants) and siblings, friends do not necessarily need to be closely related for example, unrelated mares living in a group, unrelated hyenas and many primate species (Albon *et al.,* 1992; Brent *et al*., 2013; Bercovitch and Berry, 2013). It has been shown in zebu calves that they showed interindividual grazing alliances with non–related individuals during their first year of life (Reinhardt & Reinhardt, 1981). Allogrooming (or social grooming), spatial proximity and feed sharing can be considered as indicators of friendships within an animal specie including ungulates (Boissy *et al*., 2007; Val-Laillet et al., 2009). When the intensity of allogrooming may relate to the strength of an affiliation bond or the friendship, the amount of allogrooming that is exchanged between two individual animals might relate to the degree of friendship (Val-Laillet *et al.,* 2009). It is widely accepted that social grooming is the most common social behaviour of non-human primates (Schaffner & Aureli, 2005).

Grooming provides numerous benefits to the animals, including reducing the tension of the recipient, increasing tolerance near resources, avoiding or minimizing risk of aggression, repairing disrupted relationships by conflicts, and it is important as an exchange to help received during agonistic encounters (de Waal, 1989; Kapsalisi *et al*., 1996; Barrett *et al.,* 2002; Schaffner et al., 2005). When considering ungulates, pigs and horses have been shown to have a high degree of spatial proximity between certain individuals and frequent mutual grooming (Durrell *et al.,* 2004; Val-Laillet *et al*., 2009). In cattle social grazing and social licking have been considered as amicable relationships (Reinhardt & Reinhardt, 1981).

Familiar conspecifics can lower the stress while unfamiliar conspecifics can increase the heart rate and it has been found that sheep and cattle changed behaviour and pigs lowered the body weights when they did not have their conspecifics nearby(Kenny et al.,1987; Rushen, 1987; Baldock *et al.,*1990; Takeda *et al.,* 2003). Even unrelated pigs that were reared in the same litter were less likely to fight with each other compared to litter mates that were mixed from separate litters according to one study (Stookey & Gonyou, 1998). When animals do not have their conspecifics, they show elevated levels of stress responses to different stimuli and these isolated animals conditions are known as isolation syndrome (Kikusui *et al*., 2006). Lying partner preference has been suggested as another good indicator of the social relationships in pigs (Newberry *et al.,*1986; Durrell *et al.,* 2004). Animals show a better recovery from harsh experiences when they are together with their conspecifics and this phenomenon is known as 'Social buffering' (Kikusui *et al*., 2006). Not only humans, but also non-human primates, rats, and guinea pigs have been found to have a social buffering system (Hennessy *et al*., 2002; Kikusui *et al.,* 2006).

It has been found that when squirrel monkeys encounter snakes along their plasma cortisol concentrations were higher than when they were encountering snakes in the presence of their cage mates (Takeda *et al*., 2003). Another example of social buffering has been found in baboons: Female baboons strengthen their existing bonds as a tactic to overcome the high levels of stress when a close female (usually a kin) die (Young *et al.,* 2014). Social bonds among animals seem to have stress buffering effects as it prepares the animal to cope and recover from social and non-social stress situations (Kikusui *et al*., 2006; Young *et al*., 2014; Gutmann *et al*., 2015). It has been found that the degree of social buffering effectiveness depends on the strength of the bonding or the quality of the relationship (Hennessy et al., 2009; Gutmann *et al*., 2015). Strong social relationships with conspecifics promote social stability and it is beneficial in relieving conflict situations among groups of individuals over the limited resources and in detecting and avoiding predators (Weckerly, 1999). Female baboons that are in anoestrous have been demonstrated to have high rates of long-term associations or friendships with certain un-related males (Palombit *et al.,* 1997). This might be explained by the anti-infanticide hypothesis, that female monkeys are benefited from the protection provided by male monkeys who prevent attacks from infanticidal males (Palombit *et al*., 1997). Some animals like Kakamega blue monkeys in the Kakamega forest shows obvious friendly behaviours such as sitting near to each other and grooming between animals in the same group, and this has not been detected between two groups of animals (Pazol, 2003).

Spider monkeys have species specific greeting behaviours, face greetings and whinny vocalizations that they exchange at different distance, facial gestures such as noticeable pectoral sniff and embrace that they use when they meet each other generally and when two individuals meet after a long separation time (Teixidor *et al*., 1999; Schaffner *et al*., 2005). The bonds between higher vertebrates is influenced by past mutual experiences,

environmental factors, each dyadic, triadic and polyadic impacts, the nature of each partners relationship with others, changes within the partner over time, and characteristics such as age, sex and reproductive conditions (Ganslosser, 1993). The stage concept has been suggested in order to study the progression of social bonds between alien individuals (Kummer, 1975 cited in Ganslosser, 1993). According to this concept, there is an order of interactive sequences of behaviours (i.e. fighting, presenting, mounting and grooming) when developing dyadic or triadic relationships in old world primates and rarely this sequence can be reversed (Ganslosser, 1993).

2.5 Interspecies Friendships

As one blog article describes, it has been reported a number of adorable relationships in many different species of animals all around the world and according to it has been suggested that humans are not the only species capable of feeling compassion and making long lasting friendships (Bekoff, 2012).

As there are no detailed-scientific studies done on interspecies friendships, the available scientific awareness is deficient in this field of study. However some animals form groups that consist of same species and sometimes these groups can consist of members from other species and then such a group is known as mixed-species groups, troops or flocks, interspecific association (Heymann *et al.,* 2007). Associations between mixed-species groups are well known and have been identified mainly in mammals (Stensland *et al.*, 2003), especially in primates (Waser, 1982), fish (Ehrlich *et al*., 1973), ungulates (Sinclair, 1985), and occasionally in birds (Eppley *et al*., 2015). According to Heymann (2011 cited in Eppley *et al*., 2015). When two or more animal species maintain a close proximity while communicating and synchronizing their activities over a long period of time, it is known as poly specific associations

Even though mixed-species troops are generally formed from related taxa, i.e. the same genus, family or order, it has been noted that there are also members from different orders and even classes (Heymann *et al.,* 2007). As examples, associations between birds and monkeys (Heymann, 1992), non-human primates and ungulates have been reported from Asia (SriLanka, Nepal, India) and Africa (Botswana, Kenya) could provide evidence for the existence of interspecies relationships (Newton, 1989). It has been suggested that there are often attractions between species. That can lead to the initiation of associations between different species of animals (Heymann *et al*., 2007). There are three types of proposed benefits of mixed-species groups: decreasing predatory risk, increasing foraging efficiency and resource defence (Heymann *et al*., 2007). It is not always beneficial to have interspecies associations and general costs would be feeding competition, and increased noticeability to the predators (Heymann *et al*., 2007).

In addition to terrestrial animals, fish are known to make groups consisting of their own specie (homotypic) and with individuals from multiple species (heterotypic), and this self-organizing phenomenon are called ‘schooling’ (Ehrlich *et al*., 1973; Reuter *et al*., 2016). In these fish schools, individual animals approach and follow each other while maintaining some degree of personal space around their bodies (Aoki, 1984). In one study done near to Palm islands in the Grenadines, many species and their subspecies were found to be included in a heterotypic fish school: *Mulloidichthys martinicus* (*Cuvier* and *Valenieiernes*), *Haemrulon flavo- lineaturm* (*Desmarest*), *H. plumicri* (Lace'pede), other species of *Haemnulon* and species of *Lutjanus* (snappers) (Ehrlich *et al*., 1973). However, fish repeatedly change their

relative locations and nearest neighbours within the school (Aoki, 1984). It has been suggested that there are several advantages of schooling including decreasing the risk of predation by confusion effect and reduction of individual risk (Ioannou *et al*., 2012), enhanced hunting or foraging efficiency (Packer *et al*., 1988), beneficial to follow gradients more easily, reducing the cost of energy for swimming by hydrodynamic effects (Reuter *et al*., 2016). However, schooling is not always beneficial as there are some disadvantages such as that it needs higher co-ordination efforts and a high level of competition for resources at the same time maintaining the individual survival in special environments (Amarasekare, 2003; Reuter *et al*., 2016).

2.6 Functions of interspecies friendships

It has been accepted that strong affiliation relationships both in humans and animals have a strong beneficial effects on their health and fitness (Young *et al*., 2014). A stress response is produced through activation of the hypothalamic- pituitary-adrenal (HPA) axis (Minton, 1994). When there is a challenge by the environment, animals respond with behavioural and physiological feedback mechanisms to restore the internal environment of the body and it is known as homeostasis (Korte *et al*., 2007). The stress response is the message to restore the disrupted homeostasis (Brent *et al*., 2013). It is well accepted that chronic stress is harmful to the health and reproduction as it negatively affects evolutionary fitness (Cohen *et al*., 1992; Brent *et al*., 2013). Stress reduction has been proposed as one of the eventual functions of social bonding (Brent *et al*., 2013). When there is a close social partner, the activity of the (HPA) axis is attenuated and consequently buffers the possible harmful effects of physiological stress (Young *et al*., 2014). Pair bonded partners and mothers that have infants are able to buffer the stress both in human and nonhuman animals (Rukstalis & French, 2005; Shionoya *et al*., 2007; Hennessy *et al*., 2009; Young *et al*., 2014). A careful examination of behavioural motivations behind the friendships and their physiological regulations are essential in order to clearly understand the positive fitness effects of friendships in animals (Massen *et al*., 2010).

2.7 Behavioural motivations of friendships

2.7.1 Motivation to cooperate

Level of cooperation offered by both humans and animals to another individual differ depending on which individual they are involved with. In humans, friends prioritized need more than the equity during reward distribution and even in some animals, such as chimpanzees and dogs, equity is not prioritized only when they interact with more tolerant individuals (Brosnan *et al*., 2005; Range *et al*., 2009; Massen *et al*., 2010). However, some primate species and dogs show aversive behaviours during inequity situations such as unequal reward distribution among the individuals (Range *et al*., 2009; Massen *et al*., 2010).

2.7.2 Motivations of reciprocal altruism

When animals acting in a way that another animal is benefiting while it causes certain expenses to oneself and animals act in a way that expecting a future benefit even if acting in that specific approach causes expenses temporarily it is known as reciprocal altruism (Ashton, 1998).

Reciprocal altruism is more complex than mutualism (de Waal, 2000). Animals can be unconditional in their relationships with other animals (ex. even tough the actual altruism is

believed to be costly (Burkart *et al*., 2007; Warneken *et al*., 2007; Massen *et al*., 2010). There are several mechanisms of reciprocation: (a) Calculated reciprocity, (b) Symmetry-based reciprocity, (c) Attitudinal reciprocity and emotionally mediated reciprocity.

(a) Calculated reciprocity

The ability to track value and amount of both what is received and given is known as calculated reciprocity and due to limited cognitive ability, this mechanism has a limited applicability to other animals than humans (Massen *et al*., 2010).

(b) Symmetry-based reciprocity

Here the animals tend to reciprocate (individuals interact similar with each other) according to symmetrical features of their affairs such as age, mutual association or kinship (Massen *et al*., 2010).

(c) Attitudinal reciprocity and emotionally mediated reciprocity

Here basically the ability to make reciprocal relations with a symmetrically different individual is described (Massen *et al*., 2010). When the animal makes the decision to reciprocate based on the most recent interaction with an other individual, it is called attitudinal reciprocity and when the decision is based on the general attitude it is known as emotionally mediated reciprocity (de Waal, 2000; Massen *et al*., 2010). Emotionally mediated reciprocity is unconditional and is a product of "friendship" (Massen *et al*., 2010). In some animal species, emotionally mediated reciprocity might act as the underlying mechanism of exchanging relations for ex. Chimpanzees exchange grooming, long-tailed and rhesus macaques' interchange grooming for support and sexual access (Gomes *et al*., 2009; Massen *et al*., 2010).

2.8 Hormonal regulations of friendship

It has been revealed that hormones such as oxytocin and vasopressin are involved in sociality and close social relationships (Massen *et al*., 2010). Oxytocin regulates mother–infant bonding and vasopressin regulate male typical social behaviours and is also well known for its effect as a regulator of aggressive behaviour (Carter *et al*., 2002). It has been shown that oxytocin and vasopressin can increase pair bonding in prairie voles (*Microtus ochrogaster*) when the hormone is supplied as an infusion in to the brain (Winslow et al., 1993; Williams *et al.,* 1994). In the same way a male rat increased its nonsexual interactions with a female rat after being chronically infused with oxytocin (Witt *et al*., 1992).

Seemingly both oxytocin and vasopressin help the formation and continuation of affiliation social relations (Massen *et al*., 2010). These two hormones, their homolog and their effects are not limited to rodents but also have similar effects (increasing sociality) in birds and fish species, for ex. Zebra finches increased the time spent with large groups and familiar partner birds after having been infused with mesotocin, the homolog of oxytocin and male goldfish showed stimulated approaches to conspecifics after infusion of central ofisotocin, the homolog of oxytocin and inhibited response after being centrally infused by vasotocin, the homolog to vasopressin (Thompson *et al*., 2004; Goodson *et al*., 2009). More over it has been

shown that exogenous application of oxytocin can increase the pro-social decisions, attention to others in rhesus macaque monkeys and increased trust and generosity in humans (Brent *et al.*, 2013). According to a recent study, chimpanzees that did grooming with a friend (not general grooming) showed enhanced levels of oxytocin in their urine (Crockford *et al*., 2013). There are some other substances namely endorphins, dopamine and serotonin that is important in formation and maintenance of friendships (Brent *et al*., 2013). According to some scientists, the function of oxytocin is to facilitate social interaction, while it is beta-endorphin that is critical for the formation and maintenance of social bonds (Dunbar, 2010; Brent *et al*., 2013).

2.9 Play as a mechanism of formation, and maintenance of friendships

Play occurs in many animal species including mammals, avian species, and even in reptilians (Bekoff & Byers, 1998). It has been hypothesized that play can form long lasting friendships in animals (Thompson, 1996). Even though there are no documented scientific researches done on inter-species play, there are many video recordings showing the occurrence of play even between two or more different animal species. The major neuro-transmitter systems that include dopamine, norepinephrine and serotonin systems appear to be involved in play fighting in rats (Dugatkin, 2014). Dopamine and serotonin are important in formation and maintenance of friendships (Brent *et al*., 2013) as discussed under hormonal regulation of friendship in this master thesis. Moreover it has been demonstrated that dopamine inhibitors have the ability to reduce play (Siviy *et al*., 2011; Dugatkin, 2014). Even though social bonds can be formed through different activities other than play, it has been identified that play is a mechanism involved in the formation, strengthening and maintaining of social attachments and this hypothesis is known as the cohesion hypothesis (Bekoff, 1984). In accordance with the cohesion hypothesis, Blumstein *et al*.(2009) has discovered that yearling female marmots' patterns of dispersal were influenced by the nature of their social relationships even though social factors were comparatively less influential in yearling male marmots for the dispersal. Another study did with four male gorillas, support the cohesion hypothesis and they have shown less probability of dispersal of individuals when they have more social interactions with the dominant male (Harcourt & Stewart, 1981; Blumstein *et al*., 2009). However, there are some contradictory attitudes to this hypothesis: According to Smith (1982), " It would be expected to occur mostly in species with social groups of moderate size, and not in solitary species"(cited in Bekoff, 1984). When animals engage in more mutual cohesive interactions, they remain a longer time with their social group before the dispersal or dispersal may not occur at all as a result of developing strong social bonds / friendships between individuals. However, when an animal has less or no cohesive interactions, the story reverses (Bekoff, 1977). The for mation of weak social bonds could occur due to avoidance of individuals or due to avoidance by individuals and this can be illustrated in figure 1.

Agonistic behaviour

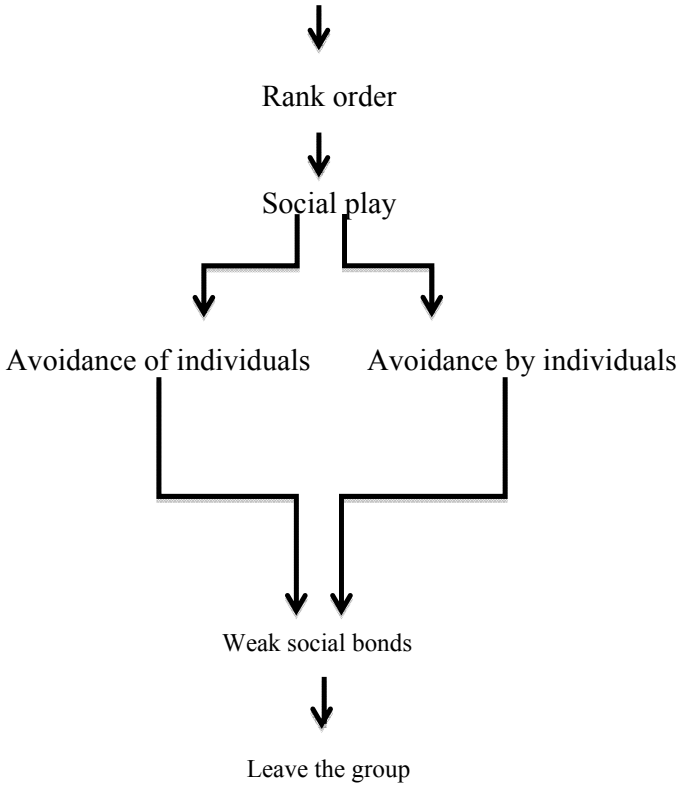

Figure 1. The diagram illustrates the hypothetical relationship between the development of social play and how less social play may lead animals to leave the group due to weak social bonds/friendships. (Bekoff, 1977). When some individuals are avoided by sibs it is called "avoidance by individuals" and when some individuals avoid interacting with sibs that is called "avoidance of individuals".

Formation of sustainable social bonds/ friendships is one of the suggested functional hypotheses of play though it has not been examined in depth (Thompson, 1996).

2.9.1 Influence of filial behaviour for developing interspecies friendships

The process of making bonds by newborn animals with their parents or with an appropriate substitute (i.e. with another animal or object) is known as filial behaviour (Mason and Kenney, 1974). Development of filial behaviour consists of filial motivation and filial imprinting (Kirkden *et al.*, 2008). It has been identified that, chicks approach and follow some noticeable objects with certain size, colours and movements that would act as alternatives to the hen and other chicks in natural environments during filial motivation (Kirkden *et al*., 2008). During filial imprinting, chicks develop a propensity to avoid objects that are not familiar and simultaneously develop a bond with objects that are more familiar (Horn, 1985 cited in Kirkden *et al.*, 2008).

2.9.2 Emotional influence of developing interspecies friendships

Do animals feel complex emotions such as compassion, empathy or love? It has been shown that emotions such as distress or pleasure from one animal or group of animals could affect another animal or group of animals in the same specie and this phenomenon is known as emotional contagion, a simple form of empathy (Reimert *et al*., 2013; Dezecache *et al*., 2015). This can occur during situations such as routine handling procedures, transport and slaughtering (Edgar *et al*., 2011; Reimert *et al.,* 2013). Further more it has been suggested that emotional contagion might occur during play, as play seems to prompt a state of pleasure (Held *et al*., 2011; Reimert *et al*., 2013). According to the cohesion hypothesis as discussed above, play lead to the formation, strengthening and maintaining of social bonds (Bekoff, 1984).

Pro-social behaviours are the acts that are targeted to benefit other individuals that are not genetically related and it is a common motivation for empathic concerns in human (Lockwood *et al*., 2014). It has been shown that, rats can help trapped cage mates (conspecifics) due to pro-social motivational state and female rats are more empathic than male rats (Bartal *et al*., 2011). Another example of pro-social behaviour is food delivery in common marmoset to unrelated individuals (Massen *et al*., 2010). Pro-social behaviour has been identified in many primates such as capuchin monkeys and bonobos (Lakshminarayanan & Santos, 2008; Massen *et al*., 2010).

3. Aim

The aim of this master thesis was to investigate the nature of interspecies friendships and which factors that could affect the beginning and continuation of such friendship by using videos available at YouTube. The questions that were asked before the study and the predictions were:

(1) Do animals that have developed interspecies friendship have experienced a stressful event as for example separation from the mother, peer or social group?

- Animals that have developed interspecies friendships have experienced stressful events such as separation from the mother, their peer or social group.

(2) Does play serve as a bridge that open up a way to start and develop a friendship between two species?

- Play open up a way to start and develop friendships between two different species of animals.

(3) Do young animals have a tendency to engage in interspecies friendships more often than older animals?

- Young animals develop more interspecies friendships than older animals.

(4) Do interspecies friendships occur more often under human captivity than in nature?

- Interspecies friendships occur more often in the captive environment.

(5) Are there any risks involved in having interspecies friendships?

- There can be risks that occur due to interspecies friendships.

4. Material & methods

4.1 Data source

This study was carried out by watching and analysing videos available on the Internet. You Tube was selected due to the availability of good quality videos in high quantity.

4.2 Experimental design

4.2.1 Pilot study

In order to get an understanding of the quality and availability of videos, a pilot study was performed during five days. Furthermore, the pilot study was useful in order to find out related videos efficiently and effectively. During the pilot study these perspectives were considered: how to do a basic video search, which search engine is more suitable, how to gather all written and visual information efficiently and effectively, how to use the eye in order to gather visual information efficiently and effectively without missing important information, how to select reliable of videos, how to select videos to record depending on quality and appropriate length, how to record the data on an A4 sheet before it was typed on an Excel work sheet.

4.2.2 Main study

During the main study 100 YouTube videos were selected after watching 150-200 videos according to the aforementioned procedure in the pilot study (see Appendix 1 for web address). During the video selection for recording, some videos were not recorded, i.e. when there was any observed direct human involvement that facilitated animal interactions, when the videos had lack of information about the animals, when both animals stayed far away from each other.

During the first stage all 100 videos were recorded on A4 papers by using continuous recording method. Instead of recording frequency or duration of all behaviours, occurrence of different types of behaviours (when there was an interaction including proximity behaviour) was recorded. The first four behaviours from the beginning of the videos were simultaneously recorded with behavioural names when it occurred.

During the second stage, all 100 videos were recorded on an Excel worksheet. All information related to the video (Source, Number, Date of watching, length of the video, species, breed, gender, age, country, region, stress event, environment and first four behaviours) were recorded. It took nine weeks and three days from the first stage to the second stage.

During the third stage, all recorded behaviours were grouped into 10 separate groups in order to make it easier for the final statistical analysis. As many animal species were involved in the

study, there were many different types of behaviours and there was a requirement for grouping more or less common behaviours together. All groups of behaviours were assigned a number from 1-10 (Table 1).

During the fourth stage, three videos were selected for further analysis based on good video quality. All behaviours were recorded as sequences (i.e. when one animal started one behaviour then the response behaviour of the other animal was recorded until the video ended). Complex behaviour sequences were converted into simple flow charts using behaviour grouping chart (i.e. similar behaviours were grouped into one common name/ behaviour) as showed in table 1. The purpose of this was to understand the basic type of behaviours that were involved in developed interspecies friendships and to try to understand the order or pattern of behaviour sequences that were involved during these friendships, if there would be any such order.

Table 1.Behaviour group numbers, group names and definitions of the included behaviours for each group used when analysing videos on interspecies interactions

Behaviour group number	Behaviour group name	Included behaviours
1	Play	Play, play fighting, friendly biting, chasing, sideway chasing, running away, running towards, body climbing, jumping towards, jumping backwards, tail play, tree climbing, body climbing, body jumping, mud-bathing, butting, pawing, circular walking, dust playing, object play, wrestling, bowing
2	Social bonding	Licking, rubbing together, rubbing, grooming, head to head contact, kissing, hugging, attempting to hug, touching, wallowing, opening mouth, sucking, mouth to mouth contact, tail wagging, head and neck rubbing.
3	Parental behaviour	Sucking, sucking nipple, holding cubs, nursing, removing piglets away
4	Proximity behaviour	Laying together, sitting together, sleeping together, swimming together, walking together, standing nearby, following, running together, moving towards, siting on the body, rolling nearby, laying nearby, body climbing, head resting, walking infront, hanging around, reaching behind, walking towards.
5	Feeding behaviour	Eating together, eating, feeding, razing, drinking milk together, drinking milk with a bottle, bush eating
6	Exploratory behaviour	Sniffing, looking face to face, manipulating grass

7	Predatory behaviours	Chasing for predation, dragging killed animal, hunting together, running away with killed pray.
8	Neutral behaviour	Walking, running, standing, laying, looking, sitting, moving forward, self sniffing, self rubbing, stretching the body, sleeping, scratching, body shaking, self licking, standing and looking at woods, standing and tail wagging
9	Dominant behaviour	Growling & pawing, throwing on the ground, attacking, unfriendly chasing
10	Other behaviour	Leash holding, pecking, shouting, leg extension, touching plants, remove the baboon from tree to ground, exciting by seeing other animal, bone biting, noticed baby baboon and abandoned the killed pray, guarding, walking away, Trying to imitate the sheep's body movements, disappearing, digging, walking away to the woods.

4.2.3 Behaviour recording procedure

All the observations were recorded by a single observer simultaneously while watching the videos. Continuous recording was used when recording behaviours. Behaviours were recorded when animals interacted with each other or when they performed behaviours close to each other (not when they were far away from each other) in order to understand what type of relationships that could occur between different species of animals. All behaviours that they performed alone during the absence of other animals were intentionally avoided when recording behaviours. The first four behaviours that were performed by the animals from the beginning of the videos were recorded when analysing data from the 100 videos. Videos with direct involvement of humans in the animal interactions were not included. When recording behaviours and making flow charts of the three selected videos, more focus was put on recording all behaviours in detail, i.e. which animal started the behaviour and which one ended it.

4.3 Data analyses

All videos were analysed using the software SAS (Statistical Analysis System Inc., Cary USA) version 9.2. Before doing calculations several types of recordings were grouped. Stress events were divided into four main categories. The environment where the inter-species "friendships" occurred was first split up into captive or natural environment, and then the captive environment was split up into seven further categories. Different ages were grouped as young (below 12 months) and adult (at and above 12 months).

Percentages of occurrences of categories within different variables were calculated by using the procedure PROC FREQ. Cross-calculations were further made by combining two variables, as for example age and type of behaviour. All analysed grouped data were used to make graphs.

5. Results

From the 100 videos a total of 221 individual animals had been filmed. These animals together represented 57 different species, which could be grouped into at least 13 orders and almost 30 families in the animal kingdom. The orders and families are presented in Table 2. The sex was reported in 106 of the 221 individuals (48%), and out of these 59.4% (63 animals) were females and 40.6% (43 animals) were males.

Table 2. Animal kingdom order, families, species and percentage of recordings of the individuals filmed during interspecies friendships (n = 221)

Order	Family	Species	Percentage
Carnivora	Canidae	Domesticated dog	22.62
	Canidae	Fox, Coyote, Hyena	2.71
	Felidae	Tiger, Lion, Leopard, Jaguar, Panther, Cheetah	15.36
	Felidae	Domesticated cat	13.57
	Ursidae, Suricata, Mustelidae, Procyonidae	Brown bear, Meerkats, Otter, Badger, Racoon, Panda	4.97
Primates	Cercopithecidae, Homidiae, Cebidae, Callitrichidae, Galagidae	Baboon, Orangutan, Capuchin, Marmoset, Galago, etc	9.03
Artiodactyla	Bovidae	Sheep, Goat, Cattle, Antelope, Wildebeest, Oryx	7.22
	Suidae	Domesticated pigs, Wild boar, Warthog	3.61
	Cervidae, Giraffidae, Hippopotamidae	Deer, Giraffe, Hippopotamus	3.62
Perissodactyla	Equidae, Rhinocerotiade	Horse, Donkey, Rhino	3.16
Rodentia	Sciuridae, Muridae, Cricetidae, Caviidae	Squiral, Mouse, Hamster, Capybara	4.06
Mammals	Leporidae, Erinaceidae, Elephantidae, Didelphidae	Rabbit, Hedgehog, Elephant, Opossum	4.07
Birds	-	Duckling, Goose, Crow, Owl, other	3.61
Reptiles & water living	-	Tortoise, Snake, Dolphine, Fish	3.16

5.1 Influence of stress events on developing interspecies friendships

According to the analysed data, animals that have developed interspecies friendships have faced some sort of stress event. The most common stress events that were found to predispose animals for developing interspecies friendships were considered to be orphaned and separation from the mother. The least common stress events that have caused development of interspecies friendships were due to an unfavourable environment and predator encounter according to the recorded data (Figure 2). A large amount of data (63.4%) was not possible to get due to lack of information in the recorded videos.

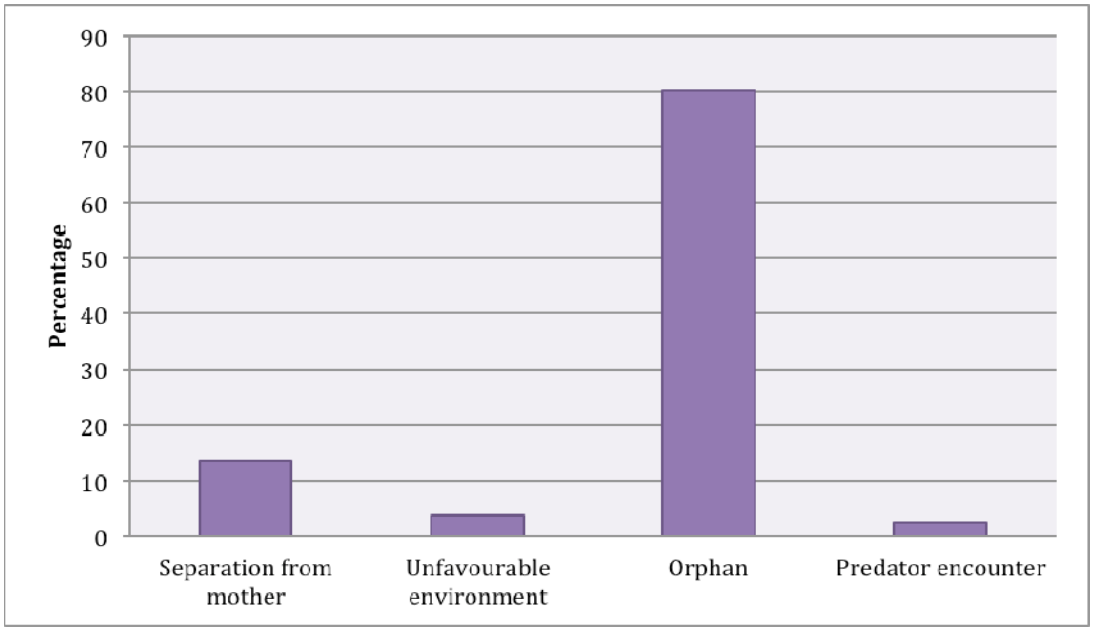

Figure 2. Percentage of videos providing information on the four most common types of stress events leading to the development of interspecies friendships (n=37 videos).

5.2 Occurrence of play and proximity behaviours in interspecies friendships

Play behaviour was recorded in a higher percentage during behaviour recording 2-4, whereas neutral behaviour had the highest recorded percentage during behavioural recording 1 (Table 3). Proximity had the second highest percentage of recordings during all four behavioural recordings (Table 3). Social bonding had the fourth place among the four most commonly recorded behaviours during interspecies friendships (Table 3).

Table 3. The most often recorded four types of behaviours during observation one, two, three and four

Behaviour recording number	Behaviour name	Percentage (%)
Behaviour recording 1	Neutral behaviour	29.0
	Proximity behaviour	20.9
	Play behaviour	20.0

	Social bonding	9.5
Behaviour recording 2	Play behaviour	20.8
	Proximity behaviour	17.7
	Neutral behaviour	17.1
	Social bonding	16.5
Behaviour recording 3	Play behaviour	28.1
	Proximity behaviour	22.3
	Neutral behaviour	13.2
	Social bonding	11.5
Behaviour recording 4	Play behaviour	30.8
	Proximity behaviour	18.5
	Neutral behaviour	16.0
	Social bonding	13.5

All behaviours that were observed during behavioural recording one, two, three and four are shown in graphs below (Figure 3, 4, 5, 6).

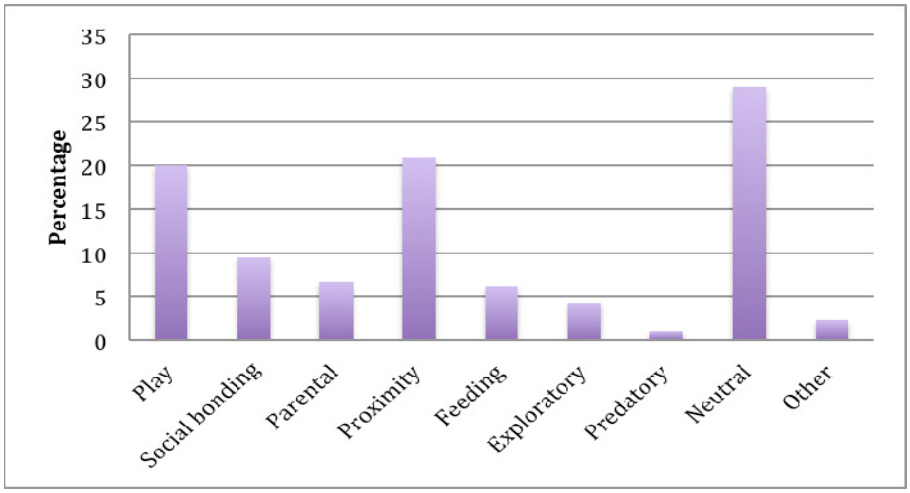

Figure 3. Percentage distribution of all behaviours that were observed during the first behaviour recording from videos showing interspecies friendships (n =100 videos).

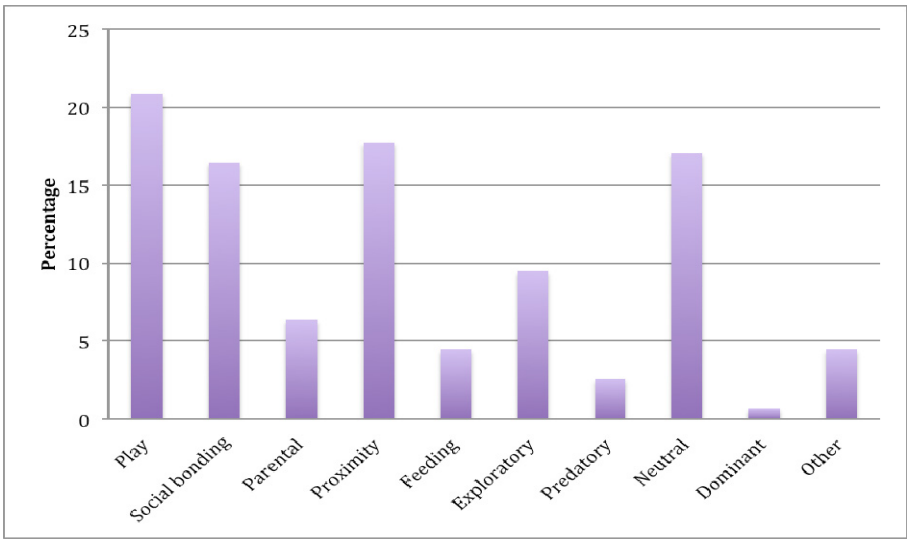

Figure 4. Percentage distribution of all behaviours that were observed during the second behaviour recording from videos showing interspecies friendships (n= 100 videos).

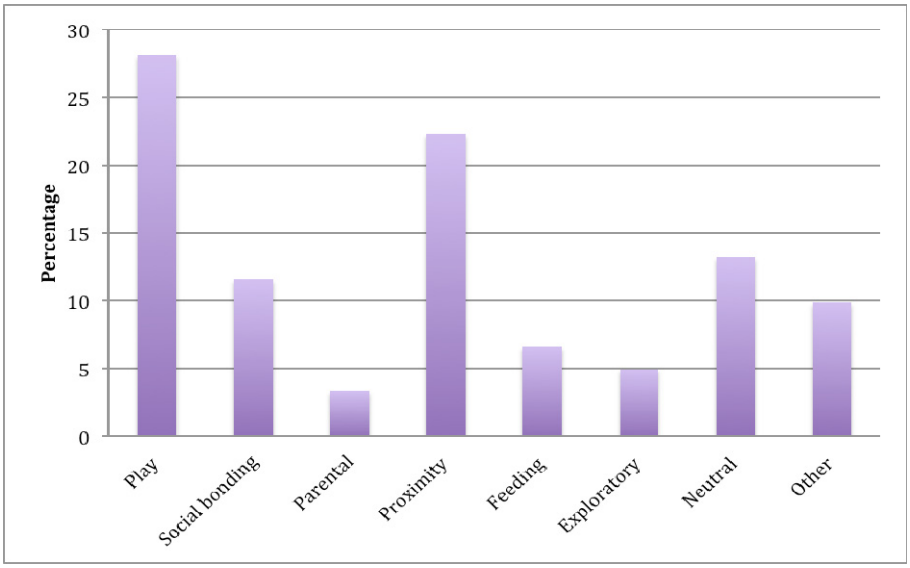

Figure 5. Percentage distribution of all behaviours that were observed during the third behaviour recording from videos showing interspecies friendships (n = 100 videos).

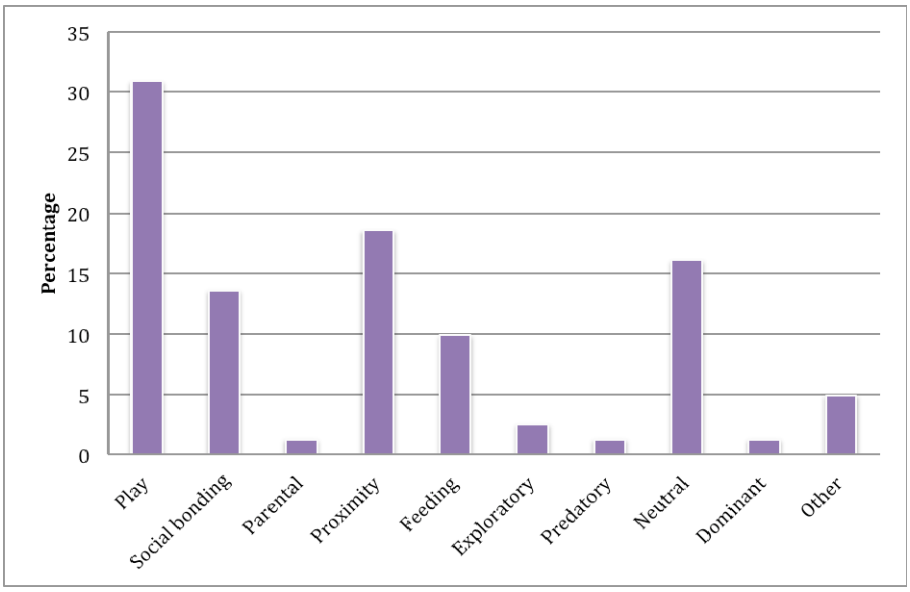

Figure 6. Percentage distribution of all behaviours that were observed during the fourth behaviour recording from videos showing interspecies friendships (n=100 videos).

Out of all 221 individual animals observed on the videos age was missing on 11 individuals and it was possible to place the others in one of the two age categories called young animals (12 months or less) or adults (older than 12 months). Out of the remaining 210 animals 91.4% (192 individuals) were young animals and 8.6% (18 individuals) were adults. When considering the occurrence of behaviour at different age categories, it appeared that both young and adult animals played more or less at a similar percentage, although the result was 0% for the adult animals in the first behaviour recording. Adult animals showed more social bonding and proximity behaviour than young animals during the four behavioural recordings. Neutral behaviour was shown in higher percentages for the young animals in the first two behaviour recordings while adult animals showed higher percentages of neutral behaviour during behaviour recordings three and four (Table 4).

Table 4. Percentage distribution for the combination of age and performing different types of behaviours during behavioural recording one-four. Animals younger than 12 months were considered as young and those who were older than 12 months were considered as adults (n=100).

Behaviour	First recording		Second recording		Third recording		Fourth recording	
	n=192	n=18	n=143	n=15	n=110	n=11	n=71	n=10
	Young	Adult	Young	Adult	Young	Adult	Young	Adult
Play	21.88	0.00	20.28	26.67	28.18	27.27	30.99	30.00
Social bonding	7.81	27.78	16.08	20.00	8.18	45.45	11.27	30.00
Parental	7.29	0.00	6.99	0.00	3.64	0.00	1.41	0.00

Proximity	7.29	27.78	16.78	26.67	22.73	18.18	18.31	20.00
Feeding	6.25	5.56	4.90	0.00	7.27	0.00	9.86	10.00
Exploratory	4.69	0.00	9.79	6.67	5.45	0.00	2.82	0.00
Predatory	1.04	0.00	2.80	0.00	0.00	0.00	1.41	0.00
Neutral	28.65	33.33	16.78	20.00	13.64	9.09	18.31	0.00
Other	2.08	5.56	4.90	0.00	10.91	0.00	5.63	0.00
Dominant	0.00	0.00	0.70	0.00	0.00	0.00	0.00	10.00

5.3 Effect of environment on developing interspecies friendships

All videos that were analysed occurred in one of two main environments (captivity or nature). It was found that interspecies friendships occurred more often in captivity than in the nature (Figure 7).

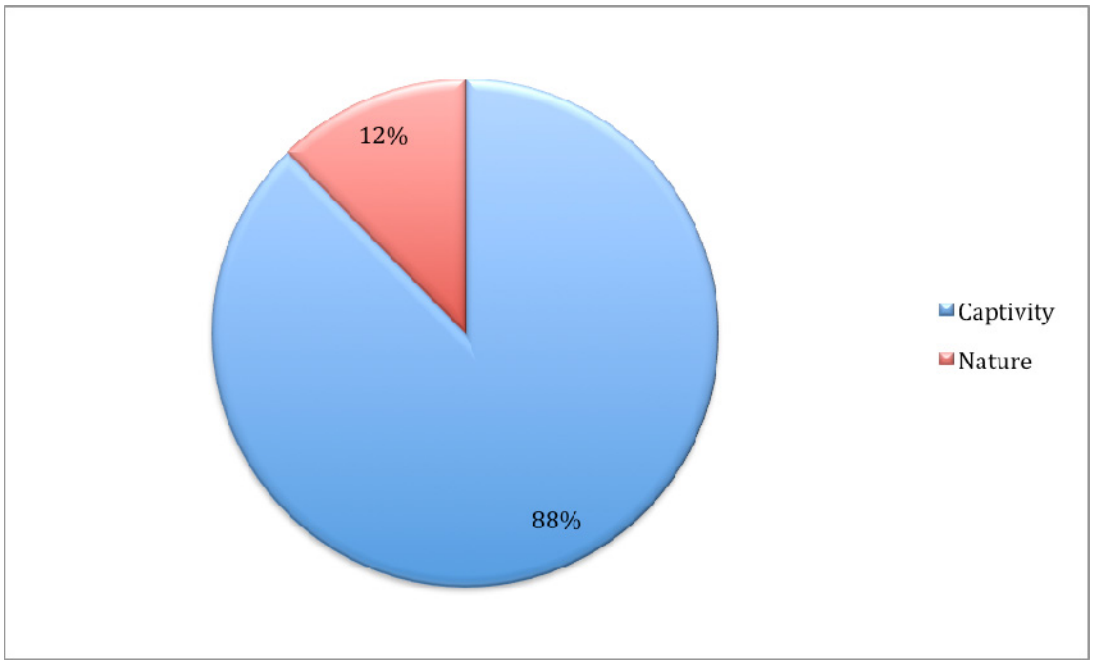

Figure 7. Percentage distribution of videos being filmed in different environment types (captive or nature) where interspecies friendships have developed (n=100 videos).

5.4 Effect of type of captivity on developing interspecies friendships

In the analysed videos, it was possible to see the different types of captive environments where interspecies friendships occurred. According to the graph, in figure 8 the highest percentage of interspecies friendships were filmed in a home environment and next in wild life parks, thereafter in an orphanage, zoological gardens, farms, one circus and one coffee shop.

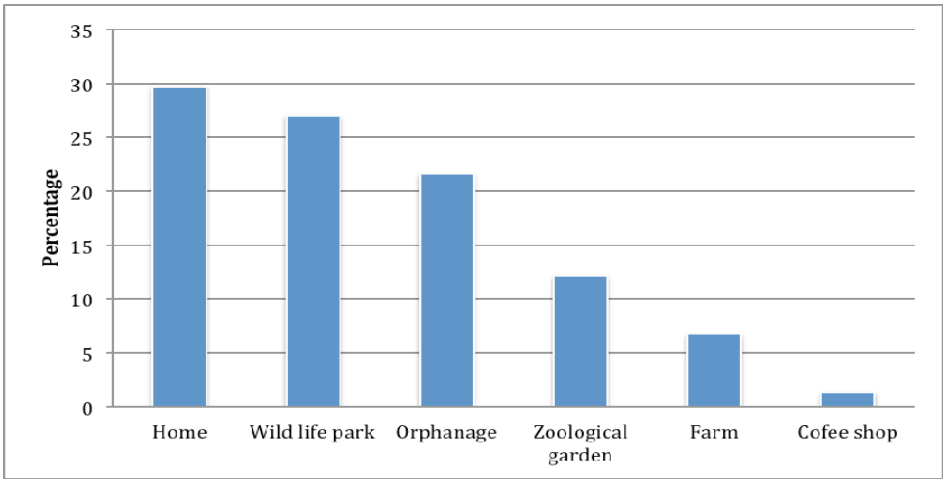

Figure 8. . Percentage of videos being filmed in different captive environments where interspecies friendships have developed (n=100 videos).

5.5 Risks involved in having interspecies friendships

On the videos, it was observed that there were some risks involved in the interspecies friendships, such as dominant behaviour and predatory behaviours. However, there were very few cases of this in the videos. From the scientific literature it seems that the risks found are mainly stress related to aggression and the relationships involving prey and predators (Table 5).

Table 5. Different types of risks involved in interspecies friendships found in the literature

Risk	Involved animals	References
Stress	Dogs and baboons	(Skylar, 2011)
Stress/accidents	An elephant and a sheep	(Ymouse, 2013)
Offensive behaviours at others	A tortoise and a goose	(Michael, 2015)
Converting friendship into predator-prey relationship	A leopard and a deer	(Barcroft TV, 2014)
Vulnerable as a prey due to increased noticeability by predators	A lion and a baby calf	(Global World Entertainment, 2014)
Anxiety due to separation	A donkey and a goat	(Animal Place, 2014)
Sudden agression	A tiger, a bear and a lion	(BBCHD Documentary, 2013)

5.6 Behaviour sequences

Behaviour sequences of three selected videos out of the100 analysed videos were recorded and converted into flow charts (Figure 9, 10, 11). Ethograms were made for the three behaviour sequences (Table 6, 7, 8).

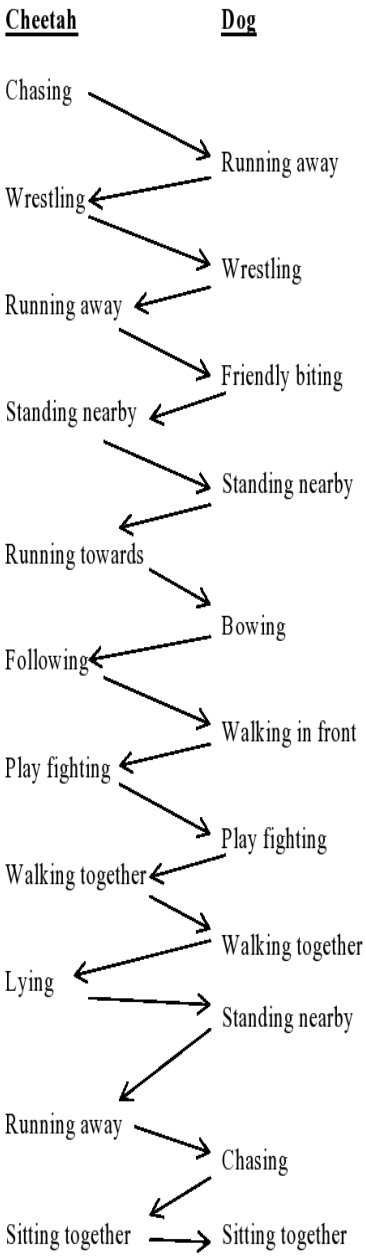

Figure 9. Behaviour sequence between a dog and a cheetah during social interactions.

Table 6. Ethogram for the behaviours shown by a dog and a cheetah during social interactions

Behaviour	Definition
Chasing	When one animal run after other animal while other animal running away
Wrestling	One or both animals cross their legs so
Running away	Escaping when other animal trying to reach or other animal not moving
Standing nearby	Standing so that four legs are in contact with the ground while maintaining closer distance to each other
Running towards	Reaching to one animal by running
Following	Walking behind one animal
Play fighting	Rapid extended body movements between two animals while walking, laying or running and biting playfully.
Walking together	Walking both animals parallel to each others body.
Laying	Laying so that animals one half of the body touching the ground, other half facing up while eyes are opened
Sitting together	Sitting close to each other
Play fighting	Biting while standing, sitting or laying when one or both animals are not showing extended movements
Bowing	Sitting so that sturnal and abdominal areas are fully contact with the ground while keeping head in lower most possible position to the ground
Walking in front	Walking before the head line of one animal

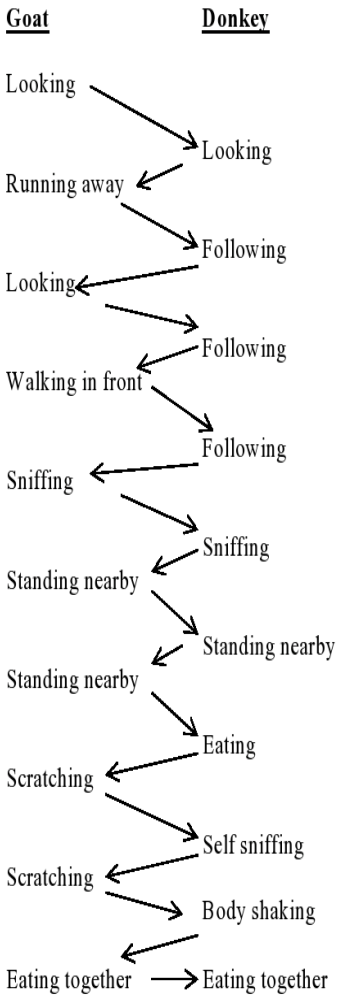

Figure 10. Behaviour sequence between a goat and a donkey during social interactions.

Table 7. Ethogram for the behaviours of a goat and a donkey during social interactions

Behaviour	Definition
Looking	Looking towards one animal while standing or walking
Run away	Escaping when other animal trying to reach or other animal not moving
Looking	Stand still and looking backward towards the other animal by turning head and neck
Walking in front	Walking before the head line of one animal
Sniffing	Both animals mouth reach closer so that the distance between not more than 6 inches
Standing nearby	Standing so that four foots are contacting the ground and not more than 5meters distance from each other
Scratching	Animal rubbing the lateral surface of the body againt the fence
Eating together	Eating in the same trough while standing nearby
following	Walking behind one animal
Eating	Standing and eating one animal in the trough
Self sniffing	Manipulating the own body by itself
Body shaking	Side to side shaking of head and neck

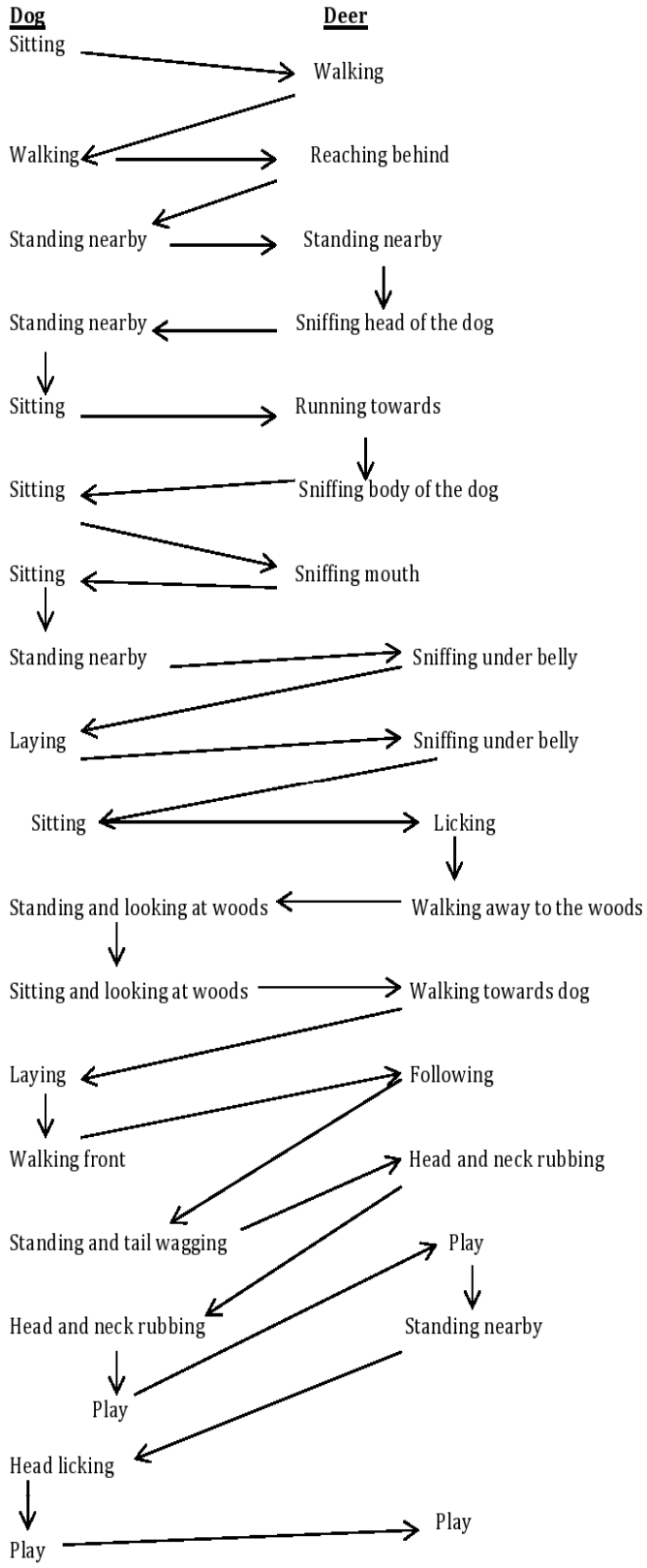

Figure 11. Behaviour sequence between a dog and a deer during social interactions.

Table 8. Ethogram for the behaviours of a dog and a deer during social interactions

Behaviour	Definition
Following	Walking behind one animal
Sniffing	Manipulating one animals head or body with the mouth without biting
Running towards	Reaching to one animal by running
Sucking	Manipulating belly area with mouth without biting
Dissappearing	Run or walk in to the woods
Rubbing	Moving the head while pressing to the other animals any of the body part
Play	Running and jumping towards, backwards and side ways from each other with rapid movements
Standing nearby	Standing so that four foots are contacting the ground and closer to each other
Licking	Manipulating one animals any of the body part by tongue
Sitting nearby	Sitting close to each other
Head resting	Keeping the head of one animal on other animals legs or back
Walking in front	Walking before the head line of one animal
Standing nearby	Standing so that four foots are contacting the ground and close to each other

Laying	Laying lateral recumbent position while keeping eyes opened
Gazing	Looking at wood more than 5 seconds continuously
Sitting	Only one animal is sitting when the other animal is totally absent
Walking away	Increasing the distance from each other by walking
Tail wagging	Moving the tail side to side while standing

6. Discussion

6.1 Role of stress on developing interspecies friendships.

Social bonds in animals have stress buffering effects, as it prepares the animal to cope and recover from social and non-social stress situations (Gutmann *et al*., 2015). Animals may have used this phenomena through out the evolution and therefore when facing stressful situations, they tend to make friendships. In this study, stress events such as being orphaned, separation from the mother, unfavourable environment and predator encounter have been identified as stress events that predispose the formation of friendships. It has been observed that hormones such as oxytocin and vasopressin are involved in sociality and close social relationships (Massen *et al*., 2010). During stress the Central Nervous System (CNS) activates the hypothalamo-pitiutory-adrenocortical (HPA) axis and sympatho-adrenal axis in mammals (Minton, 1994; Kick, 2011). Adrenocorticotropic hormone (ACTH), which is an important component in the HPA axis, is responsible for production and secretion of adrenocorticoids (Minton, 1994). Secretion of (ACTH) appears to be regulated by Corticotrophin Releasing Hormone (CRH), Vasopressin (VP) and a variety of other peptides (Minton, 1994).

The combination of CRH and VP enhances the secretion of ACTH in some farm animals that have been studied (Minton, 1994). Therefore it is logical to assume that when animals encounter stress VP increases and it contributes to the formation and development of friendships. Perhaps this would be a good topic for further studies. During stressful situations, animals need to make abnormal or extreme changes in their physiology or behaviour to cope with the stress (Dybkjær, 1992). Interspecies friendships might be considered as an extreme behavioural change that occurs in order to cope with the stress. Therefore, stress may lead to the formation of interspecies friendships. When conspecific animals are together, it leads to the reduction of stress level (Kikusui *et al*., 2006). It has been observed that stressed rats were more highly attracted to the other animals than non-stressed rats and they do so in order to reduce the negative emotions or in order to obtain positive neuro-chemical rewards (Kikusui *et al*., 2006). It has further been found that shared stress experience can lead to an increased attraction between human partners (Kikusui *et al*., 2006).

6.2 Play facilitate the start and development of friendships

According to this thesis, play behaviour was the behaviour that occurred in the highest percentage in three out of four behaviour recordings. Formation of long-lasting social bonds can be considered as a function of play (Thompson, 1996; Dugatkin, 2014). Therefore, it is logical to argue that long-lasting social bonds are as friendships and play may be regarded as a facilitating mechanism that helps to start and develop the friendships. However, in another study there were not enough evidence to suggest that play act as a mechanism for making long-lasting friendships between calves or between calves and other members of the group (Thompson, 1996). It has been suggested that play is contagious and therefore it may generate positive excitement in one animal when it is experienced by another animal that is engaged in play thus evoking play (Reimert *et al*., 2013). Playmates must cooperate to avoid shifting play into fighting or mating during play (Allen *et al*., 2005). If cooperation is an important characteristic during play it might facilitate the development of friendships. Play occurs not only in mammals but also in many avian and some reptilian species as reported by Siviy *et al*. (2011). This may lead to a wide variety of animal species to develop interspecies friendships through play. Individuals compare their physical competence through play with

their peers (Thompson, 1996). Therefore when animals meet, they may start to play as they want to make a self-assessment and as play itself is entertaining they continue and finally it might lead to a long-lasting friendship.

According to Boissy *et al*. (2007), provision of animals with opportunities for play is one way to induce positive experiences in animals. Further, it has been described that certain behaviours such as play, dust bathing, social behaviour, reproductive behaviour and grooming seem to have rewarding properties which means that animals positive affective states could be induced by acquiring these rewards (Boissy *et al*., 2007; Chapagain *et al*., 2014). The reward cycle is a model that can be used to explain different stages of how animals can reach positive emotional states, and it consists of three subsequent phases namely; appetitive phase, consummatory phase and post-consummatory phase (Seehuus *et al.,* 2012). During the appetitive phase the animal search and anticipate a resource, during the consummatory phase the animal consumes and enjoys the resource and when the animal attains satisfaction it is the post-consummatory phase (Chapagain *et al*., 2014). Therefore, animals may be willing to continue performing play behaviours with animals of other species due to a possibly experienced positive emotional state and this in turn may develop and maintain interspecies friendships.

6.3 How different ages affects on interspecies friendships

In this study most films were made on younger animals that were less than 12 months old and only a few on older animals. This may reflect that either it is more common in younger animals to perform interspecies interactions or that it is more common that humans video film younger animals when the have interspecies interactions. According to data analysed in this project, it was found that both young and older animals performed play behaviours at a more or less similar level. These results are not showing the same results as conspecifics which found that play behaviour was frequently shown in young animals interacting with conspecifics (Dobao *et al*., 1985; Newberry *et al*., 1986). More old animals in this study engaged in more social bonding and proximity behaviours than young animals. Play may act as an initial mechanism that helps to promote friendships (Bekoff, 1984). Thereafter animals can spend more time in close proximity and finally it turns into social bonds. Therefore it is logical to argue that young animals make more interspecies friendships through play than through the other two types of behaviours while older animals make friendships more through proximity behaviour and social bonding. On the video films it was not possible to get information about for how long the friendships had existed. In more old animals it could have started with play and then turned into more proximity and social bonding over time, but this we do not know. It is difficult to say that age has any influence on the forming of interspecies friendships.

6.4 Friendships occur more often in human captivity than in nature

According to this thesis, 88% of interspecies friendships had improved in captivity and 12% of friendships had developed in nature. This indicates that when animals are in a captive environment, they tend to form more friendships than when they are in the nature. However, development of interspecies friendships could also happen more frequently in nature, but it is much more difficult to find them. For example, a photographer has a blog with several photos of a wolf and a brown bear in the forest of Finland where they were observed to interact friendly and seemed to have formed a bond (web page address). As videos made in the nature

were not available in high numbers for the analysis it was not possible to make a judgement based on the current data.

6.5 Interspecies friendships are not always beneficial

Animals that are involved in interspecies friendships are not always benefited from their relationships. There are a lot of risks that can affect them negatively. Such risks will be discussed from here on. Guinea pigs *(Cavia porcellus)* may be affected negatively when being reared together with rabbits *(Oryctolagus cuniculus)* as rabbits grow and sexually mature faster than guinea pigs and they may try to mate with guinea pigs. This can cause immense stress on the guinea pigs which affect their health and welfare (Lidfors, 2016, pers. comm., 8 August). One video that was analysed during this thesis showed that dog pups faced immense stress when baboons tried to manipulate them in an aggressive way (Skylar, 2011). According to the video, baboons kidnapped dog pups and seemingly they tried to adopt them in order to make them live with baboons in the same area. With time dogs lived with the baboons in the same group, but the initial taming process seems to be stressful as baboons physically harass pups. Therefore it might affect the dog welfare.

Some friendships start after an unfriendly chasing (e.x. Friendship between elephant and sheep) (Ymouse, 2013). This kind of chasing might cause stress for both animals. Also chasing is dangerous as both animals can face accidents and injuries thereafter. As different species of animals have different physiological capacities, animals with lower capacity can be affected negatively. Individual/s in an interspecies friendship sometimes show offensive or defensive behaviour towards other animals when other animals reach them. This might affect other animals negatively (e.x. Friendship between tortoise and goose) (Michael, 2015).

In some occasions, there is a risk of converting a good looking friendship into a predator and prey relationship. Predatory animals lives depend on hunting and it is doubtful how long such predators can maintain a friendship with a herbivore animal. Perhaps this kind of relationship might end as soon as the predator feels hungry (e.x. “Friendship” between leopard and deer) (Barcroft TV, 2014).

Sometimes being in an interspecies friendship enhances the risk of being a prey by another animal outside the friendship as a result of increased noticeability by predators (Heymann *et al.*, 2007; Global World Entertainment, 2014). However, it has been noted that fish that are in interspecies fish schools have reduced predator risk dramatically by the confusion effect and reduction of individual risk (Packer *et al*., 1988).

Seemingly individuals in an interspecies relationship are emotionally bonded together and it can result in unbearable anxiety or stress after separation or death of one individual in the friendship (e.x. Friendship between goat and donkey) (Animal Place, 2014). In another study, spider monkeys show greeting behaviours (Face greeting, Whinny vocalizations, Facial gestures) when they meet each other after a long separation time. This indicates their emotional bond (Schaffner *et al.*, 2005; Teixidor *et al.,* 1999). If they are able to bond emotionally, it might cause anxiety and stress at separation. There is a risk of developing aggression between individuals in a friendship and sometimes it provokes fights that might end with severe injuries to both partners according to one documentary (e.x. Friendship among tiger, bear and lion) (BBCHDDocumentary, 2013).

Different species of animals have their unique structural, functional and other differences. As an example cattle and goat have horns and horses do not have horns and therefore they differ

between each other structurally. Another example of a structural difference is dog and deer. Dogs have sharp teeth while deer do not have sharp teeth. As both partners in an interspecies friendship are not the same the most vulnerable one could receive more negative consequences if they fight. However, animals may probably understand their limits and they adjust to the other animal during their relationship. In one video, when a dog (Great Dane) played with a deer (Wild blacktailed deer), it played in a milder way than it normally did with another dog (BBC, 2013).

6.6 Behaviour sequence analyses

When analysing three selected videos, it was observed that there were many behaviours in the actual behaviour sequences as showed in the result section. However, after comparing with the main behaviour group categories (See Appendix 2), it was possible to convert the data into more simple flow charts (Figure 14, 15 and 16). Therefore, these flow charts can be utilised to understand the basic nature and patterns of behaviours in interspecies friendships.

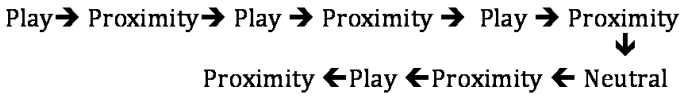

Figure 14. Behaviour sequence between cheetah and dog, the behaviour sequence started with play and ended with proximity behaviours even though behaviour type shifted from time to time from play to proximity behaviour and vice versa.

Perhaps animals show more proximity behaviours after play as it has been hypothesized that play can form long lasting friendships in animals (Thompson, 1996). Even though social bonding might occur through different activities, play may be considered as one of the most important factor in facilitating the formation and maintenance of social attachments and this hypothesis is known as the cohesion hypothesis (Bekoff, 1984). However, some researches do not agree with the cohesion hypothesis (Smith, 1982).

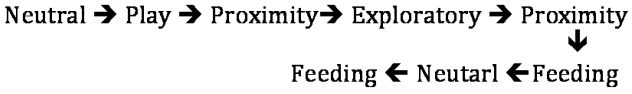

Figure 15. Behaviour sequence between goat and donkey, Even though the animals displayed neutral behaviours at the very beginning, they developed a close relationship so that they could stay at close proximity.

Perhaps exploratory behaviours may help to understand each other before they strengthen their relationship. Thereafter they showed feeding together that can be considered as a sign of developed friendship as both partners want to have a sufficient degree of tolerance for each other in order to feed together.

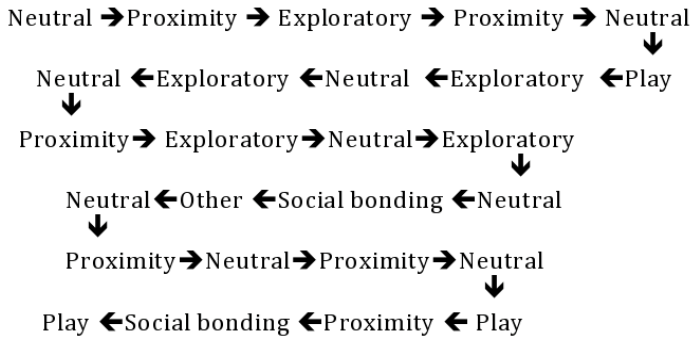

Figure 16. Behaviour sequences between dog and deer, showing behaviour sequence start with neutral behaviour and it shifts into different behaviours as shown in the figure and finally end up with play.

The behaviour sequence in figure 14 is more complex and it can be observed that both animals take a longer time to get to know each other through exploring each other. Thereafter they developed some bond and it may appear as proximity behaviour. After that the animals have shown play that might facilitates strengthening of a friendship. They have shown proximity behaviour again as the next behaviour and it may have helped to develop a social bond between each animal. It is not obvious from the video if this was in the beginning of an interspecies friendship, but it could be speculated that this is how such a friendship may develop.

6.7 Experimental challenges

It was difficult to find good quality videos. Also, it was not so easy to acquire all the information related to the videos, as an example age and sex of the animals. Reliability of videos was important as it could affect the final outcome of this study. Some videos were neglected when it was suspected as a direct creation by humans rather than a genuine friendship, i.e. for the purpose of getting public attention. Some other videos recorded even when there was some human involvement for the beginning and continuation of animal relationships. After recording 100 videos, it was harder to find more high quality videos for the study. That was a major limitation of this study. Also it would have been good to analyse more videos filmed in the nature even though they were rare in YouTube compared to videos showing such animal relationships in captivity.

6.8 A possible model for the formation of interspecies friendships

During physiological and psychological stress situations, oxytocinergic neurons are activated and oxytocin is secreted as a result (Windle, 1997; Kikusui *et al*., 2006). Cortisol is also secreted into the circulation due to the activation of the HPA axis (Kick, 2011). Oxytocin can reduce cortisol secretion by affecting adrenal glands negatively and lead to avoidance of the occurrence of pathological conditions due to chronic stress (Kikusui *et al*., 2006; Kick, 2011). Lactation can act as a stimulation to secrete oxytocin as mothers' nipples get stimulated during sucking by new-born animals (Kikusui *et al*., 2006). Finally oxytocin helps to attenuate the stress responses by improving social behaviour and anxiety reduction (Windle, 1997; Young *et al*., 2014) (see figure 17).

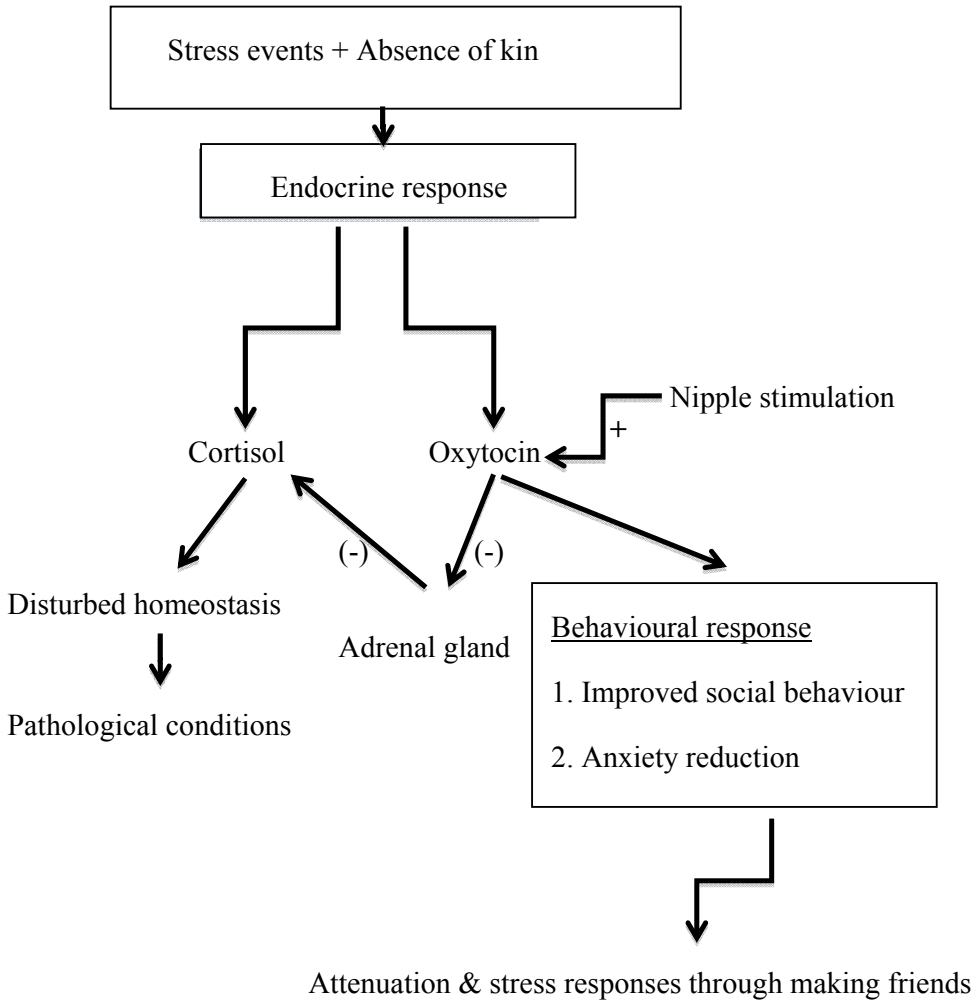

Figure 17. The schematic diagram illustrates a possible mechanism for the formation and function of interspecies "friendships". Stress events when the absence of kin elicits endocrine responses in animals. Mainly oxytocin and cortisol secretion occurs. Cortisol disturbs homeostasis and causes diseases. But oxytocin can reduce the cortisol release by negatively affecting on the adrenal gland. And also oxytocin can initiate behavioural responses such as improved social behaviour and anxiety reduction. Many interspecies "friendships" started as a result of the stress event and it occurs with the involvement of oxytocin.

6.9 A definition for interspecies friendships

Seemingly animals may reduce stress through making friendships with animals of another species with the presence or absence of their own kin. By doing this they can avoid health and reproductive problems caused by stress and thus the animals gain enhanced welfare. Based on the suggestions of J. King (2010) and Brent *et al*. (2013), I would like to propose a definition for the interspecies friendship as,

"Sustainable, altruistic or reciprocal relationships between two or more different animal species in nature or captive environment where they interact with a certain frequency and consistency of affiliation behaviours which are non-reproductive and non-aggressive"

6.9.1 Suggestions for the future research

This project was done based on YouTube videos and it was not possible to focus on one pair of friends in depth due to the short duration of videos. If one reported interspecies friendship could be studied in detail over a longer time, it may reveal different and new information about such friendships. If a new study is planned to be carried out it would be good to prepare a questioner for the owners of the animals that know more information about the pair of friends.

7. Conclusions

After analysing all the data in this study the following conclusions are made:

1. Stress events, such as being an orphan or being separated from the mother, may act as a predisposing factor for development of interspecies friendships.

2. Play behaviour, proximity to other animals and social bonding were the most commonly recorded behaviours on films with interspecies friendships.

3. Mainly young animals have been filmed when they engage in interspecies friendships and slightly more females than males were involved in the interspecies interactions.

5. Young animals appear to make more interspecies friendships through play whereas adults appear to make more interspecies friendships through social bonding and proximity to other animals.

6. Interspecies friendships have been filmed more often in human captivity than in nature, and mainly in private homes, wild life parks, orphanages and zoological gardens.

7. Interspecies friendships are not always beneficial but involve risks.

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Appendix 1

Details about YouTube videos showing the country, that the incident reported, and its URL including missing data.

Country	URL
Canada	https://youtu.be/dLSkuTNiU9E
Canada	https://youtu.be/dLSkuTNiU9E
South Africa	https://youtu.be/dLSkuTNiU9E
South Africa	https://youtu.be/dLSkuTNiU9E
Atlantic georgia	https://youtu.be/dLSkuTNiU9E
Atlantic georgia	https://youtu.be/dLSkuTNiU9E
Atlantic georgia	https://youtu.be/dLSkuTNiU9E
United states	https://youtu.be/dLSkuTNiU9E
United states	https://youtu.be/dLSkuTNiU9E
Ireland	https://youtu.be/dLSkuTNiU9E
Ireland	https://youtu.be/dLSkuTNiU9E
Kenya	https://youtu.be/dLSkuTNiU9E
Kenya	https://youtu.be/dLSkuTNiU9E
Brazil	https://youtu.be/dLSkuTNiU9E
Brazil	https://youtu.be/dLSkuTNiU9E
Brazil	https://youtu.be/dLSkuTNiU9E
USA	https://youtu.be/dLSkuTNiU9E
USA	https://youtu.be/dLSkuTNiU9E
South Africa	https://youtu.be/dLSkuTNiU9E
South Africa	https://youtu.be/dLSkuTNiU9E
South Africa	https://youtu.be/w30hgwFkXd8
South Africa	https://youtu.be/w30hgwFkXd8
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.	https://youtu.be/73j84pvHXFo
Kenya	https://youtu.be/tOn2RhH36Mc
Kenya	https://youtu.be/tOn2RhH36Mc
.	https://youtu.be/_BQ6Bh0hHqQ
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.	https://youtu.be/JE-Nyt4Bmi8
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SriLanka	https://youtu.be/nG6qj_HupzA
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.	https://youtu.be/KE9sQfuur_E
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.	https://youtu.be/sumn6flhNtg

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